Federal state – funded educational institution of higher education

**“Financial university under the Government of the Russian Federation”**

**Department of Mathematics**

«Approved"

Head of Department

Mathematics

Ass. Prof. Zadadaev S.A.

**Pyrkina Olga Evgenievna.**

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**Risk management & Derivatives**

**SYLLABUS**

***Level of Study:*** *Master’s Degree*

***Field of Study:*** *38.04.01 Economics*

***Study Program:*** *International Finance (in English)*

Moscow 2021

**1. Name of a subject Risk management & Derivatives**

**2. Mapping of learning outcomes (list of competences), with the relevant indicators described and subject learning outcomes indicated.**

 Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| Code and Type of competence | Name of Master degree graduate’s professional competence | Description of Professional Competence Development Indicators | Learning outcomes (skills, and knowledge) and indicators that show competence development  |
| PC-4Analytical | Ability to develop methodology and to assess economic project efficiency taking into account risk factors in the presence of uncertainty. | 1. Develops and uses economic project efficiency assessment methodology in the presence of uncertainty..  | Have a knowledge of theoretical and practical aspects of contemporary mathematical theory of derivatives and mathematical methods of risk management, as well as financial economic models based on these theory and methods Have skills for application of probabilistic methods for risk measuring and management, with possible utilization of derivatives and combinations of derivatives  |
| 2. Has skills needed to make research-based conclusions in the form of methodologies and analytical materials in order to make managerial economic project implementation decisions | Have a knowledge of exact and approximate methods for analysis of efficiency of derivatives’ application and for risks’ prognosticationHave skills for * Making conclusions on possibility of derivatives usage for risks minimization on the base of derivatives analysis;
* Developing mathematical models, with due account of risks factors in a context of uncertainty;
* Obtaining an interpretation of simulation results for managerial decision-making
 |
|  |
| Competence code | Program Additional Competences | Competence development indicators[[1]](#footnote-1) | Learning outcomes (skills[[2]](#footnote-2), and knowledge) and indicators that show competence development  |
| AC-3 | Ability to examine the financial markets’ key segments’ structure, identify the connections between the segments, and use the international financial market regulation practices. | Plans, conducts and monitors the financial market trade operations results. | Have a knowledge of • stock performance system, applied in world financial practice for quantitative and qualitative estimations pf financial risks and derivatives Have skills for Contemporary financial information systems (Bloomberg, Thomson Reuters) for- obtaining financial information, concerning risk estimation at key financial market segments- risk management in financial markets, with due account of all factors’ linkage - application of information obtained for constructing and regulating of risk management system in financial market, in accordance with international requirements and standards, as well as with world accepted practice. |

**3. Place of the subject in the curriculum**

A course “Risk management and derivatives” is a discipline of profession-oriented course elective units deepening the master program knowledge for program track 38.04.01 Economics, Concentration: International Finance (in English). This course is given during 4 module, 4 hours a week.

The knowledges, skills and competences, obtained in learning of “Probability theory and mathematical statistics” and/or “Data analysis” courses are necessary to study this course “Risk management and Derivatives”.

**4. Workload in credits and academic hours, with class work (lectures and seminars) and self-study indicated**

The data are presented in the form of a table.

Table 2

|  |  |  |
| --- | --- | --- |
| **Type of work**  | **Total** **(in credits and hours)** | **Module 4**  **(in hours)** |
| **Overall workload**  | ***3 / 108***  | ***108*** |
| ***Class work***  | ***40*** | ***40*** |
| *Lectures*  | ***10*** | ***10*** |
| *Seminars, practicals*  | ***30*** | ***30*** |
| ***Self study***  | ***68*** | ***68*** |
| Formative assessment  | ***Control work*** | ***Control work***  |
| Summative assessment  | ***End-of-term test*** | ***End-of-term test*** |

**5. Subject content (with the thematic components indicated).**

**Topic 1**. **Financial risks and classification: statement of the problem, history, contemporary Basel rules**

1.1. Necessity of risk management

1.2. Banking regulations. History of the problem and contemporary demands: Basel II, Basel III.

**Topic 2. Derivatives and application in risks-management**.

2.1. The main notions of derivatives theory. The one-step binary (binomial) model of option pricing

2.2. The multiperiod binary models.

2.3. The Black-Scholes model.

**Topic 3. Foundation of risk theory**

3.1. Value at risk (VAR)

3.2. Portfolio risk – analytical methods

3.3. Backtesting VAR. Stress – testing.

3.4. Risk and correlation prognostication

3.5 Contemporary practice of risk-management

**6. List of teaching and methodological materials needed for the students self-study**

**6.1. List of questions for student self-study and types of out-of-class activities**

Table 3

|  |  |  |
| --- | --- | --- |
| **Itemized subject content**  | **Questions the students should answer within the self-study process**  | **Types of out-of-class activities**  |
| 1. Necessity of risk management
 | 1. Financial risks: classifications
2. How banks can lose money
3. Market Risk
4. Credit Risk
5. Operating Risk
6. Blends of Risks
7. Managing risk at the macro level
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Banking regulations. History of the problem and contemporary demands: Basel II, Basel III
 | 1. What is “capital management”?
2. Distinction is between regulatory capital and economic capital
3. Regulatory Capital
4. Three pillars of the Basel II Capital Accord
5. The market risk charge
6. Basel III in present-day world
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Option pricing in single – period modes. The one-step binary (binomial) model
 | 1. A Call and Put options
2. Setting Up a Riskless Portfolio. Valuing the portfolio
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Trading strategies involving options
 | 1. Strategies involving a single option and a stock
2. Spreads
3. Bull Spreads
4. Bear Spreads
5. Butterfly Spreads
6. Calendar Spreads
7. Combinations.
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. The multiperiod binary model
 | 1. Backwards induction
2. Recombinant (binomial) trees
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Brownian motion as a model for stock market behavior.
 | 1. The concepts of a stochastic processes
2. Markov processes and Markov property
3. Continuous-time stochastic processes:
4. Wiener Processes
5. lto Process
6. The process for stock prices
7. Brownian motion
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. The Black-Scholes model
 | 1. Lognormal property of stock prices
2. The distribution of the rate of return
3. Volatility
4. Estimating volatility from historical data
5. Concept underlying the Black-Scholes- Merton differential equation
6. Ito’s lemma
7. Derivation of the Black-Scholes-Merton differential equation
8. Risk-neutral valuation
9. Black-Scholes pricing formulas
10. Implied Volatility
11. The causes of volatility
12. Dividends: European Options
13. American Options
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. The Greek letters
 | 1. Naked and covered positions
2. A stop-loss strategy
3. Delta hedging
4. Delta of European Stock Options
5. Delta of Other European Options
6. Delta of Forward Contracts and Futures Contract
7. Dynamic Aspects of Delta Hedging
8. Delta of a Portfolio
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Computing VAR
 | 1. A formal definition of VAR.
2. Steps in Computing VAR
3. Nonparametric VAR
4. Parametric VAR
5. Why VAR as a Risk Measure?
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Backtesting VAR
 | 1. Setup for backtesting
2. Concepts of hypothesis testing
3. Model backtesting with exceptions
4. Applications
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Stress Testing
 | 1. Why stress-testing?
2. Principles of scenario analysis
3. Portfolio- versus Event-Driven
4. Generating unidimensional scenarios Sensitivity Tests
5. Multidimensional scenario analysis
6. Prospective Scenarios
7. Historical Scenarios
8. Stress-testing models and parameters
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Portfolio Risk: Analytical Methods
 | 1. Portfolio VAR
2. VAR tools
3. Examples
4. From VAR to portfolio management
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Forecasting Risk
 | 1. Forecasting Risk and Correlations: Time-varying risk or outliers?
2. Modeling time-varying risk:
3. Moving Averages
4. GARCH Estimation
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Forecasting Correlations
 | 1. Modeling correlations: Long-Horizon Forecasts
2. The RiskMetrics Approach
3. Moving Averages
4. GARCH
5. Exponential Averages
6. Crashes and Correlations
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars  |
| 1. Practice of risk-management.
 | 1. Implied Volatilities: ISDs as Risk Forecasts
 | Student's independent work with tutorials and with follow-up discussions of FRM (Financial Risk Management) Exam questions during the seminars |

**6.2. List of questions/assignments/topics for students’ preparation to formative assessment**

**6.2.1. An example of typical questions for students’ preparation to formative assessment**

1. What is the interpretation of the marginal VAR for an asset?
2. All else equal, will portfolio risk decrease or increase under the following scenarios?
3. Correlations increase,
4. Volatilities increase.
5. The number of assets increases,
6. Assets move more closely together.
7. Assuming normal distributions, relate the risk of a portfolio invested (long) in two assets with correlation of 1 with the risks of the two assets.
8. Assuming normal distributions, relate the risk of a portfolio of two assets (long one asset and short the other) with correlation of — 1 with the risks of the two assets
9. Assume a portfolio is equally invested in *N* assets that have the same volatility of 10 percent and equal pairwise correlation. If the average correlation is 0.2, as *N* grows large, the portfolio volatility will tend to what number?
10. VAR is claimed not to be a *coherent risk measure.* Explain the meaning of this term and whether this criticism applies to normal distributions
11. Given the following risk report, which asset serves as a hedge?

|  |  |  |  |
| --- | --- | --- | --- |
|  | 1. Position
 | 1. Marginal VAR
 | 1. Component VAR
 |
| 1. Asset 1
 | 1. $2
 | 1. 100
 | 1. $200
 |
| 1. Asset 2
 | 1. $1
 | 1. -100
 | 1. -$100
 |

1. What is the relationship between marginal VAR and incremental VAR?
2. On average, what is the relationship between component VAR and individual VAR for a particular position?
3. How can we derive component VAR directly from marginal VAR?
4. A portfolio manager takes active positions relative to the benchmark. The manager considers changing one of the positions by a fixed amount. To reduce risk, should the manager focus on individual VAR, marginal VAR, or component VAR?
5. Define the *best hedge*
6. If the risk of a portfolio of stocks has been minimized, do you expect the individual VAR/marginal VAR/component VAR to be zero/the same?
7. If a portfolio of stocks has been optimized to have the highest Sharpe ratio, do you expect the individual VAR/marginal VAR/component VAR to be the same/proportional to expected returns?
8. An investor holds a position that includes:
	1. $100,000 invested in a 10-year Canadian government bond futures contract (CGB)
	2. $ 100,000 invested in a Canadian stock index futures contract (SXF).
9. Their annual volatility is 5 and 20 %, respectively, with a correlation of —0.50.
10. Assume that returns are normally distributed. VAR should be measured over 1 year at the 95% confidence level using the 1.645 quantile.
11. Answer the following questions:
	1. What are the diversified VAR and undiversified VAR?
	2. What is the marginal and component VAR of CGB and SXF, respectively?
	3. What is the incremental VAR from setting CGB to zero

**6.2.2. Example of home task for presentation “case study” preparation**

For the beginning, would you be so kind to look through this list of quite exceptional cases of financial trading losses and choose one of these cases for your case study task. <https://en.wikipedia.org/wiki/List_of_trading_losses>

There are some links for detailed description and analysis, you could also use some other sources of information.

You should fulfill the following tasks:

1. To write a short essay (**no more than 2 pages**) and to send it for your professor no later than .
2. To prepare a presentation in PowerPoint and to make a short report (**no more than 5 minutes**) in one of future seminars.

It is necessary to capture the following points in your essay/report:

1. What has happened in the case under consideration?
2. What wrong solutions and wrong activity did result in these exceptional losses?
3. What should be done to prevent these losses?
4. What strategy could you recommend to avoid such potentials in future?

You will find below the list of students, who have chosen this option course. You should choose the point in the list of cases in Wiki according to your number in this list, automatically. If you prefer to use some other case for analysis, would you be so kind to make agree by e-mail with your colleges and write your professor. The date of your essay/report is the number of corresponding seminars in the last column.

**6.2.3. An example of Home control work**

Consider a virtual portfolio. Your portfolio consists of two assets: I and II.

These assets are characterized by the following parameters

|  |  |  |
| --- | --- | --- |
|  | Asset I | Asset II |
| Total value of portfolio, $ mln | W |
| Volatility of an asset, annual |  |  |
| Correlation coefficient |  |
| Expected return, annual  |  |  |

**Your Task:**..

An initial information, necessary for Home task, could be obtained by two ways.

1. Choose the initial numerical values from the Table 3 according to your number in your group name list.
2. Or (preferably) use real assets time series data, taken from sites like "MFD - InfoCenter" <https://mfd.ru/export/> and carry out computing a necessary numerical characteristics by yourself by means of Excel or R tools

**Then do the following operations with these characteristics.**

1) Write down a covariance matrix 

2) Determine the vector of initial investments, where  and  are investments in the Asset I an Asset II correspondingly

3) Calculate the portfolio variance as a product 

4) Calculate portfolio VAR (diversified)

5) Calculate the sum of two assets’ VARs (undiversified VAR for portfolio)

6) Calculate vector of Betas as 

7) Now you can see, which portfolio position should be increased and which should be decreased to improve your portfolio risk characteristics. Your aim is to create a portfolio with equal betas for both components – this portfolio will have the least VAR.

Use Excel to carry out few steps of optimization to obtain components’ betas, different no more than in the second decimal digit.

8) Present your results in form of the following Table 1. **Risk-minimizing position**

|  |
| --- |
| **Risk-minimizing position** |
| Asset | Original position, % | Beta | Final position, % | Beta |
| I |  |  |  |  |
| II |  |  |  |  |
| Total | 100 |  |  |  |
| Diversified VAR |  |  |  |  |
| Undiversified VAR |  |  |  |  |
| Standard deviation |  |  |  |  |

9) Now take into account both risks and returns of your portfolio. That means you should maximize the Sharpe ratio  for your portfolio. In the point of optimum the ratio  for both portfolio components should be equal to each other. Start from the **Risk-minimizing position** and carry out few steps of optimization to obtain Sharpe ratios different no more than in the second decimal digit.

In the point of optimum calculate the diversified VAR, expected return and Sharpe ratio for your final portfolio.

10) Present your results in form of the following Table 2. **Risk and return-optimizing position**

|  |
| --- |
| **Risk and return-optimizing position** |
| Asset | Expected return  | Original position, % | Beta  | Ratio  | Final position, % | Beta  | Ratio  |
| I |  |  |  |  |  |  |  |
| II |  |  |  |  |  |  |  |
| Total |  | 100 |  |  | 100 |  |  |
| Diversified VAR |  |  |  |  |  |  |  |
| Standard deviation |  |  |  |  |  |  |  |
| Expected return for portfolio  |  |  |  |  |  |  |  |
| Sharpe ratio for portfolio |  |  |  |  |  |  |  |

**Table 3. Data for optimization problem, according to the nominal list below**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **N** | **W** |  |  |  |  |  |
| 1 | 5 | 0.05 | 0.10 | 0.3 | 0.05 | 0.15 |
| 2 | 6 | 0.06 | 0.12 | 0.25 | 0.06 | 0.16 |
| 3 | 8 | 0.07 | 0.15 | 0.28 | 0.08 | 0.18 |
| 4 | 10 | 0.05 | 0,14 | 0.24 | 0.05 | 0.22 |
| 5 | 4 | 0.08 | 0.15 | -0.20 | 0.12 | 0.16 |
| 6 | 5 | 0.10 | 0.12 | -0.15 | 0.10 | 0.18 |
| 7 | 6 | 0.12 | 0.15 | 0.12 | 0.13 | 0.20 |
| 8 | 3 | 0.08 | 0.12 | -0.15 | 0.17 | 0.25 |
| 9 | 10 | 0.06 | 0.11 | 0.23 | 0.06 | 0.23 |
| 10 | 12 | 0.04 | 0.15 | 0.32 | 0.07 | 0.15 |
| 11 | 10 | 0.12 | 0.10 | 0.16 | 0.12 | 0.19 |
| 12 | 6 | 0.15 | 0.05 | 0.22 | 0.11 | 0.16 |
| 13 | 8 | 0.12 | 0.15 | 0.30 | 0.08 | 0.18 |
| 14 | 5 | 0.07 | 0.10 | 0.13 | 0.07 | 0.16 |
| 15 | 4 | 0.06 | 0.14 | 0.25 | 0.12 | 0.18 |
| 16 | 2 | 0.07 | 0.17 | -0,18 | 0.15 | 0.25 |
| 17 | 12 | 0.08 | 0.14 | -0.24 | 0.18 | 0.25 |
| 18 | 16 | 0.06 | 0.15 | -0.21 | 0.05 | 0.20 |
| 9 | 10 | 0.04 | 0.12 | 0.23 | 0.06 | 0.15 |
| 20 | 8 | 0.05 | 0.10 | 0.18 | 0.07 | 0.12 |
| 21 | 6 | 0.08 | 0.12 | 0.26 | 0.06 | 0.16 |
| 22 | 5 | 0.06 | 0.16 | 0.12 | 0.12 | 0.18 |
| 23 | 4 | 0.05 | 0.11 | -0.21 | 0.12 | 0.22 |
| 24 | 3 | 0.07 | 0.10 | 0.18 | 0.10 | 0.18 |
| 25 | 2 | 0.08 | 0.15 | -0.22 | 0.08 | 0.16 |

**6.2.4. Examples of typical control test questions**

1. A trader buys a call option with a strike price of $45 and a put option with a strike price of $40. Both options have the same maturity. The call costs $3 and the put costs $4. Draw a diagram showing the variation of the trader's profit with the asset price.
2. Suppose that a March call option to buy a share for $50 costs $2.50 and is held until March. Under what circumstances will the holder of the option make a profit? Under what circumstances will the option be exercised?
3. Suppose that a June put option to sell a share for $60 costs $4 and is held until June. Under what circumstances will the seller of the option (i.e., the party with the short position) make a profit?' Under what circumstances will the option be exercised?
4. A trader writes a September call option with a strike price of $20. It is now May, the stock price is $18, and the option price is $2. Describe the trader's cash flows if the option is held until September and the stock price is $25 at that time.
5. A trader writes a December put option with a strike price of $30. The price of the option is $4. Under what circumstances does the trader make a gain?
6. A trader enters into a short forward contract on 100 million yen. The forward exchange rate is $0.0080 per yen. How much does the trader gain or lose if the exchange rate at the end of the contract is (a) $0.0074 per yen; (b) $0.0091 per yen
7. The volatility of a stock price is 30% per annum. What is the standard deviation of the percentage price change in one trading day?
8. Calculate the price of a three-month European put option on a non-dividend-paying stock with a strike price of $50 when the current stock price is $50, the risk-free interest rate is 10% per annum, and the volatility is 30% per annum.
9. A stock price is currently $40. Assume that the expected return from the stock is 15% and that its volatility is 25%. What is the probability distribution for the rate of return (with continuous compounding) earned over a two-year period?
10. A stock price follows geometric Brownian motion with an expected return of 16% and a volatility of 35%. The current price is $38. (a). What is the probability that a European call option on the stock with an exercise price of $40 and a maturity date in six months will be exercised? (b). What is the probability that a European put option on the stock with the same exercise price and maturity will be exercised?
11. What is the price of a European call option on a non-dividend-paying stock when the stock price is $52, the strike price is $50, the risk-free interest rate is 12% per annum, the volatility is 30% per annum, and the time to maturity is three months?
12. What is the price of a European put option on a non-dividend-paying stock when the stock price is $69, the strike price is $70, the risk-free interest rate is 5% per annum, the volatility is 35% per annum, and the time to maturity is six months?

**6.2.5. Theoretical questions for preparing to a final test.**

1. Explain carefully the difference between writing a call option and buying a put option.
2. Explain carefully the difference between writing a put option and buying a call option.
3. Explain why an American option is always worth at least as much as a European option on the same asset with the same strike price and exercise date.
4. List the six factors affecting stock option prices.
5. Give two reasons why the early exercise of an American call option on a non-dividend-paying stock is not optimal. The first reason should involve the time value of money. The second reason should apply even if interest rates are zero.
6. "The early exercise of an American put is a tradeoff between the time value of money and the insurance value of a put." Explain this statement.
7. Explain why an American call option is always worth at least as much as its intrinsic value. Is the same true of a European call option? Explain your answer.
8. What is the effect of an unexpected cash dividend on (a) a call option price and (b) a put option price?
9. A company knows that it is due to receive a certain amount of a foreign currency in four months. What type of option contract is appropriate for hedging?
10. What view about the market is reflected in the following strategies? (a) *Bullish vertical spread:* Buy one European call and sell a second one with the same expiry date, but a larger strike price.
11. What view about the market is reflected in the following strategies? *Bearish vertical spread:* Buy one European call and sell a second one with the same expiry date but a smaller strike price
12. What view about the market is reflected in the following strategies? *Strip:* Buy one European call and two European puts with the same exercise date and strike price
13. What view about the market is reflected in the following strategies? *Strap:* Buy two European calls and one European put with the same exercise date and strike price
14. What view about the market is reflected in the following strategies? *Strangle:* Buy a European call and a European put with the same expiry date but different strike prices (consider all possible cases).
15. "If most of the call options on a stock are in the money, it is likely that the stock price has risen rapidly in the last few months." Discuss this statement.
16. Give an intuitive explanation of why the early exercise of an American put becomes more attractive as the risk-free rate increases and volatility decreases.
17. What is meant by a protective put? What position in call options is equivalent to a protective put?
18. Explain two ways in which a bear spread can be created.
19. When is it appropriate for an investor to purchase a butterfly spread?
20. What trading strategy creates a reverse calendar spread?
21. What is the difference between a strangle and a straddle?
22. Explain how an aggressive bear spread can be created using put options.
23. Use put-call parity to show that the cost of a butterfly spread created from European puts is identical to the cost of a butterfly spread created from European calls.
24. Explain the no-arbitrage and risk-neutral valuation approaches to valuing a European option using a one-step binomial tree.
25. What would it mean to assert that the temperature at a certain place follows a Markov process? Do you think that temperatures do, in fact, follow a Markov process?
26. Can a trading rule based on the past history of a stock's price ever produce returns that are consistently above average? Discuss.
27. Variables and  follow generalized Wiener processes with drift rates  and  and variances  and . What process does  follow if the changes in  and  in any short interval of time are uncorrelated?
28. Variables and  follow generalized Wiener processes with drift rates  and  and variances  and . What process does  follow if there is a correlation  between the changes in  and  in any short interval of time?
29. Stock A and stock В both follow geometric Brownian motion. Changes in any short interval of time are uncorrelated with each other. Does the value of a portfolio consisting of one of stock A and one of stock В follow geometric Brownian motion? Explain your answer.
30. The process for the stock price is , where  and  are constant. Explain carefully the difference between this model and each of the following: ,

,



Why is the first model in equation  a more appropriate model of stock price behavior than any of these three alternatives?

1. It has been suggested that the short-term interest rate, r, follows the stochastic process , where a, b, and с are positive constants and  is a Wiener process. Describe the nature of this process.
2. What does the Black-Scholes stock option pricing model assume about the probability distribution of the stock price in one year? What does it assume about the continuously compounded rate of return on the stock during the year?
3. Explain the principle of risk-neutral valuation.
4. What is implied volatility! How can it be calculated?
5. Show that the Black-Scholes formulas for call and put options satisfy put-call parity.

**7. Mandatory and optional reading list**

**7.1. Mandatory reading list:**

* 1. Pyrkina O.E. Mathematical foundation of risk analysis and risk management (in Russian): Text of lectures. / O.E. Pyrkina; Finuniversitet. — Moscow: Finunivarsitet, 2013 — 141 pp. — [Electronic source]. — available at: <http://elib.fa.ru/rbook/Lectures%20on%20risks.pdf/view>
	2. García F.J.P Financial Risk Management. Identiﬁcation, Measurement and Management [Electronic source]. – Springer Nature; Palgrave Macmillan. – 2017. - 392p. - Access from local area network of Financial university (reading, printing). - available at: <https://link.springer.com/book/10.1007/978-3-319-41366-2>

**7.2. Optional reading list:**

* 1. Pyrkina O.E. Stochastic models of risks and derivatives analysis (in Russian) [Electronic source]: Textbook for mater students / O.E. Pyrkina Finuniversitet, Department of data analysis, decision making ad finance technologiesй. — Moscow: Finuniversitet, 2017. — 1 CD – available at: <http://elib.fa.ru/rbook/pyrkina_1829.pdf>
	2. Kudryavtsev A.A. Introduction into quantitative risk management (in Russian) [Electronic source]: Textbook / A.A. Kudryavtsev, A.V. Radionov. - SPb: SPbGU. - 192 pp. - available at: <http://znanium.com/catalog/product/941170>
	3. Fred E. Benth, Giulia Di Nunno. Stochastics of Environmental and Financial Economics [Electronic source] / Centre of Advanced Study; DOAB. - Norway, Oslo, 2015. – 138 p. - (Book Series: Springer Proceedings in Mathematics & Statistics). - Access from local area network of Financial university (reading, printing). - available at: <https://link.springer.com/book/10.1007/978-3-319-23425-0>

<https://www.doabooks.org/doab?func=search&uiLanguage=en&template=&query=stochastic>

**8. List of IT resources, incl. the list of software, information and reference systems (as appropriate).**

**8. 1. Software:**

1. Windows, Microsoft Office software;

2. ESET Endpoint Security antivirus software;

**8.2. Databases and information and reference systems**

1. <http://www.garp.org/#!/home>

2. <https://www.msci.com/risk-performance>

3. <https://www.msci.com/analytics>

4. <http://www.rusrating.ru>

* 1. <http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=428389>
	2. <https://www.bankofengland.co.uk/statistics/research-datasets>

7. Electronic library of Financial University (EL) http://elib.fa.ru/ (<http://library.fa.ru/files/elibfa.pdf>)

8. Springer Nature e-book collection <http://www.library.fa.ru/resource.asp?id=608> SpringerLink

9. E-book system «University library on-line» <http://biblioclub.ru/>

10. Electronic library system Znanium <http://www.znanium.com>

11. Scientific electronic library eLibrary.ru <http://elibrary.ru>

12. . <http://ru.wikipedia.org/wiki/Wiki> e-encyclopedia

**8.3. Certified software/hardware used for information protection**

Certifies software is not used.

1. To be filled in when the updated Financial University educational standards and federal state educational standards of higher education “3++” are implemented. [↑](#footnote-ref-1)
2. Skills are described when the Financial University educational standards of the 1st generation and federal state educational standards of higher education “3+” are implemented. [↑](#footnote-ref-2)